**INTERNATIONAL ORGANISATION FOR STANDARDISATION**

**ORGANISATION INTERNATIONALE DE NORMALISATION**

**ISO/IEC JTC 1/SC 29/WG 7**

**CODING OF MOVING PICTURES AND AUDIO**

**ISO/IEC JTC 1/SC 29/WG 7 m55993**

**Online – January 2021**

**Title: [G-PCC] EE13.47 report on spherical coordinate geometry**

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# Abstract

This contribution is a report of EE13.47 on spherical coordinate geometry[2].

In current G-PCC specification, only cartesian coordinates (x, y, z) is supported as the input/output format of geometry. For example, when use the angular mode on predictive geometry coding, input geometry with cartesian coordinates (x, y, z) is converted to spherical coordinates (r, j, i) and the spherical coordinates data is encoded.

However, the sensor may output in the data format of the spherical coordinate system (ex. Velodyne LiDAR) that include vector of the reflectance per angle of sensor.

In this contribution, additional consideration was conducted based on the proposal m55361[1] that propose new predictive geometry angular coding method to encode/decode the spherical data.

# Encoder process on Predictive Geometry Coding

Figure 1 shows a diagram of the encoder for predictive geometry coding.

Currently predictive geometry coding support two coding mode (angular mode on / off) that encode the cartesian coordinate input data. We proposed to add the new method that can encode the spherical coordinate input data with angular mode with no additional process.

This new method:

Point1: can input spherical coordinate data directly.

Point2: can quantize the residual even when no conversion error (residual 2).

Point3: no additional process (select the existing function by 1bit flag).

## Input/output format: Cartesian coordinate, Angular mode: OFF

When encoding the cartesian coordinate data with the Cartesian coordinate system (angular mode = OFF), prediction, residual generation, quantization, and entropy coding are processed.

## Input/output format: Cartesian coordinate, Angular mode: ON

When encoding the cartesian coordinate data with the Spherical coordinate system (angular mode = ON), the input data is converted from cartesian coordinate to spherical coordinate. Residual by predicting is encoded with spherical coordinate as Residual 1, and the residual due to coordinate transformation is quantized and encoded as Residual 2.

## Input/output format: Spherical coordinate, Angular mode: ON [Proposal]

When encoding the spherical data with the Spherical coordinate system (angular mode = ON), the input data can be encoded with spherical coordinate system (angular mode = ON) directly.

The process of coordinate conversion and Residual 2 encoding are not necessary compared to encoding with the Cartesian coordinate system. Instead of quantization of Residual 2, Residual 1 is quantized.

Each function to achieve this new encoding method is already included in the conventional encoder, so it can be easily achieved by switching the existing process.

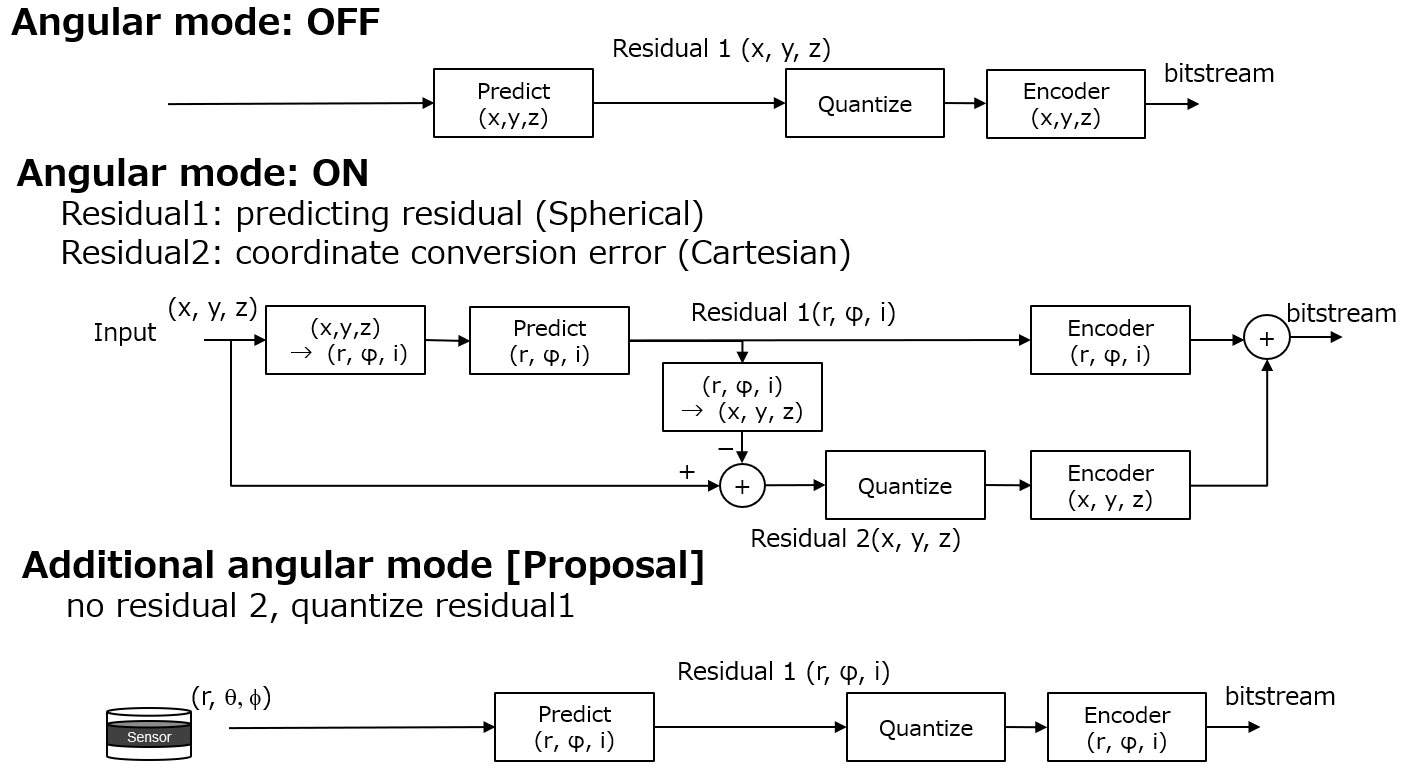


Figure A diagram of the Encoder

# Decoder process on predictive geometry coding

Figure 2 shows a diagram of the encoder. The process of the decoder is opposite of the encoder process.

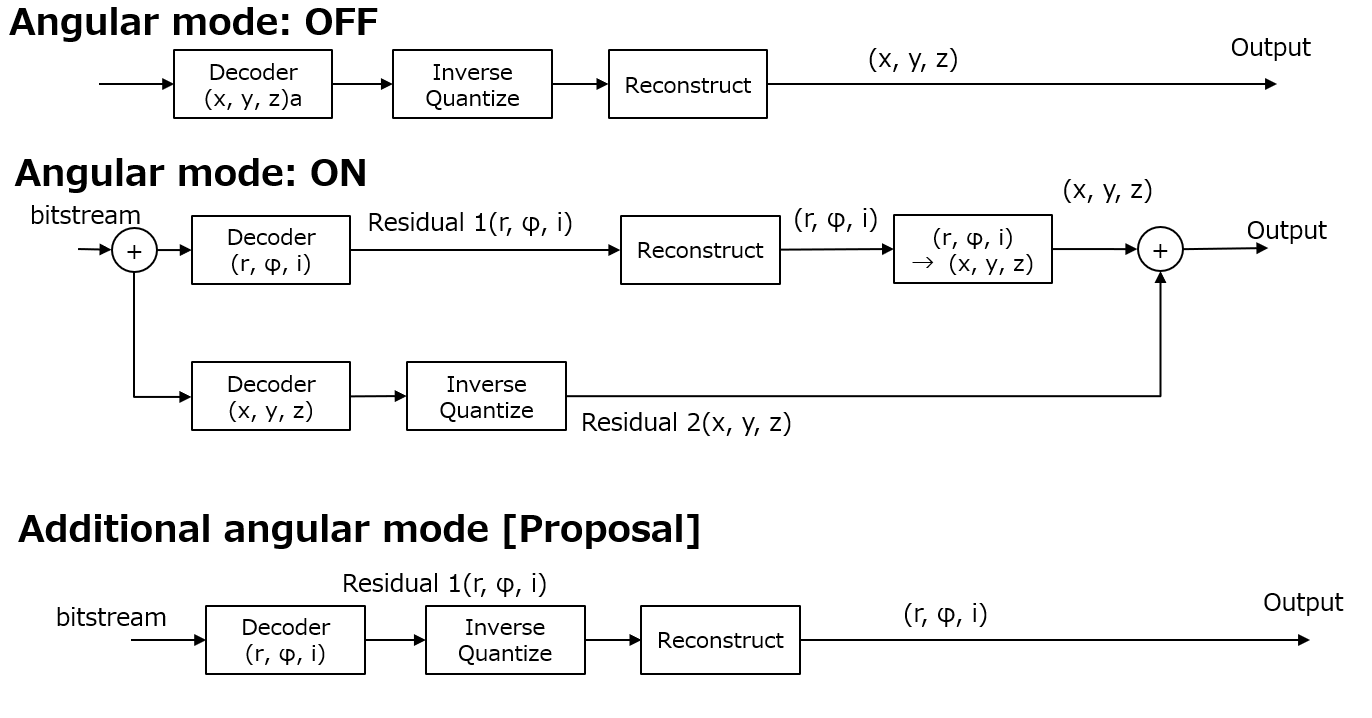


Figure A diagram of the decoder

# gps\_geom\_spherical\_enabled\_flag

Introduces a new flag **gps\_geom\_spherical\_enabled\_flag** in order to switch the coordinate conversion processing is used or not. In combination with **angular\_mode\_enabled\_flag**, it can be switched between 3 modes.

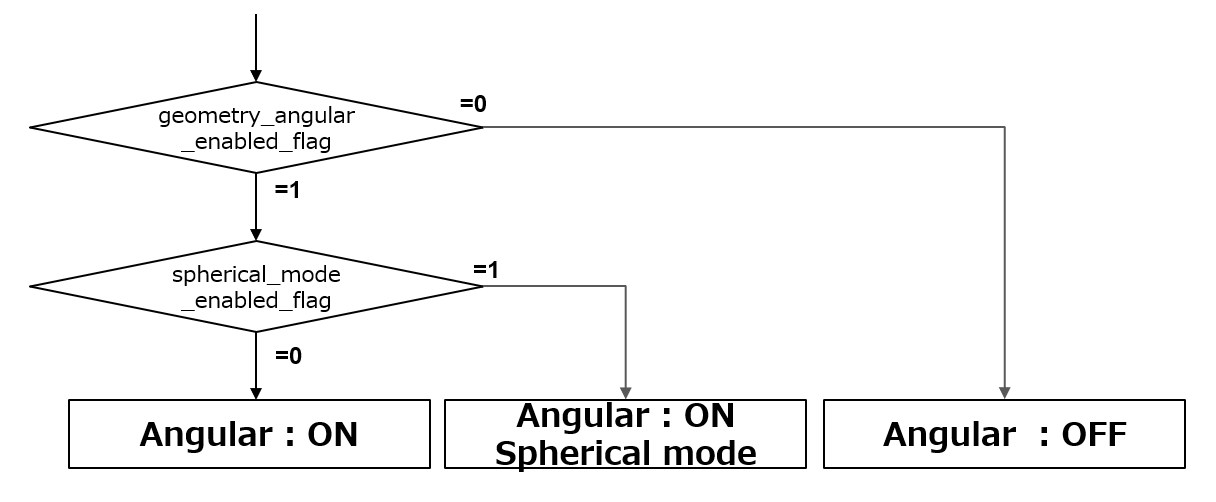


Figure The flow to select the mode

# Combination with spherical attribute coding

When using spherical mode, the coordinate of geometry decoder output is spherical coordinate. Attribute decoding can be achieved by using spherical attribute coding.

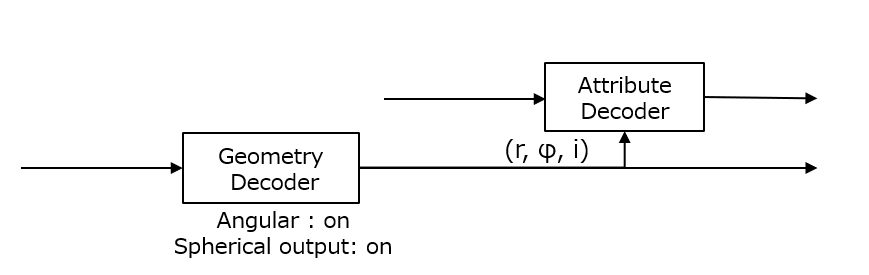
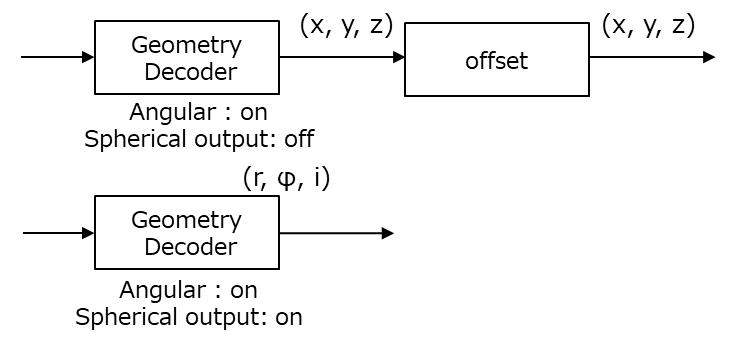


Figure Decoder

# Origin offset

When using the cartesian coordinate for output, positions are offset by the value of angular\_origin and slice\_origin after decoding. But in the case the output is spherical coordinate, offset is not needed.

So, we propose to skip the offset process from the decoder process, and to remove the syntax of origin parameter from the GPS and data unit header.

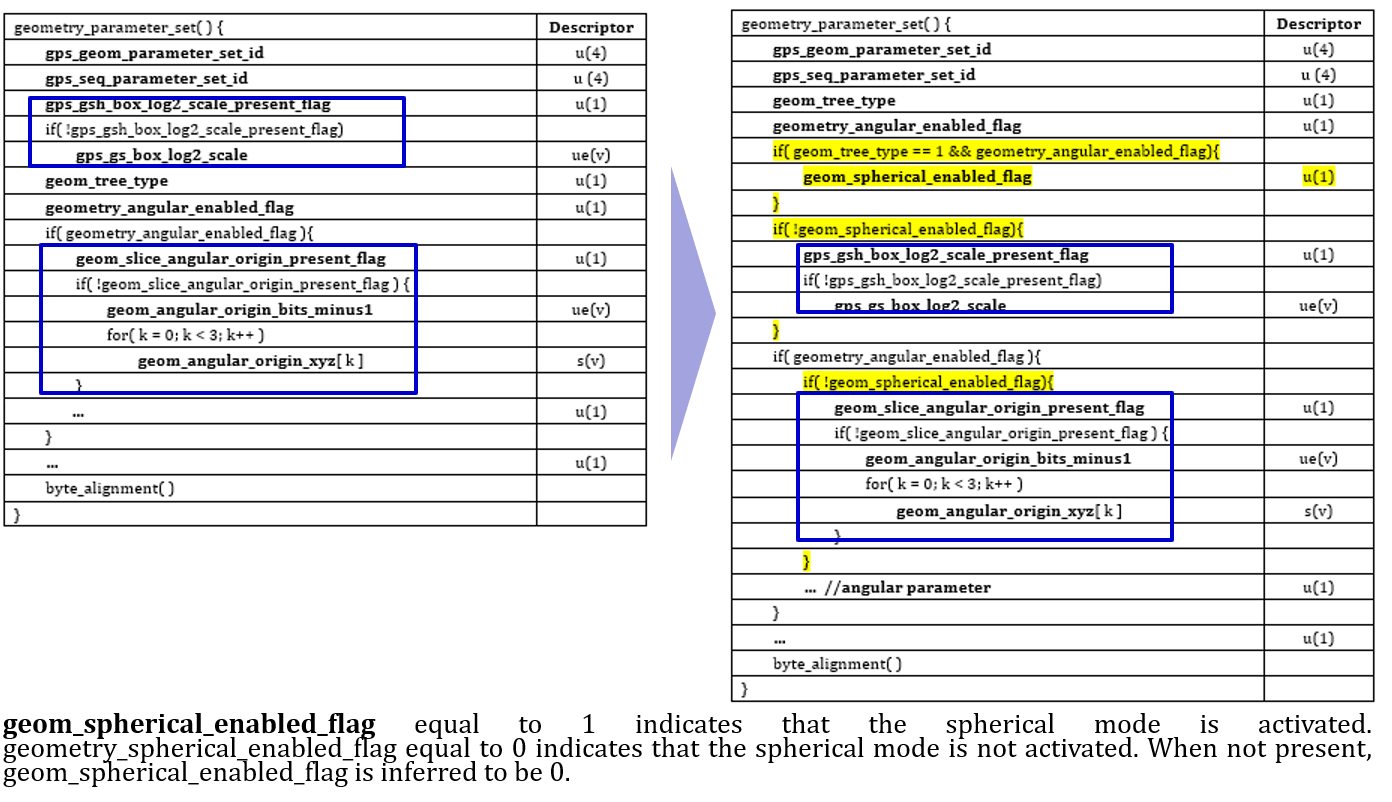


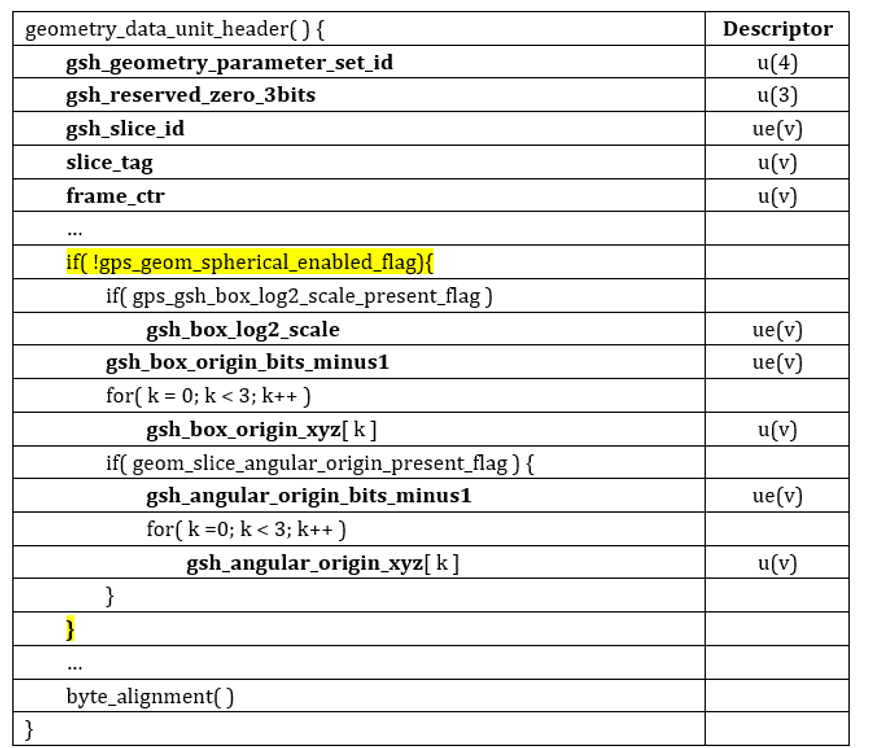
# Proposed Syntax and semantics

Table 1 shows the proposed syntax.

1. Add 1 bit flag that indicate spherical mode in GPS
2. Signal *origin* only when not spherical mode in GPS and data unit

Table Proposed Syntax





# Conclusion

We proposed the new coding mode that encode the input data with spherical coordinate with predictive angular mode.

* Add new coding mode for predictive angular mode
  + No additional process, the function has already included in the original process.
* Select the existing process by **gps\_geom\_spherical\_enabled\_flag**
* Skip the offset process after decoding
* Remove the offset syntax from GPS and data unit

We recommend adopting this proposed method.

# References

1. [G-PCC][New] Predictive geometry angular mode using spherical LiDAR data input, ISO/IEC JTC1/SC29/WG7 MPEG2020/m55361 October 2020, Online.
2. Description of EE4FE 13.47 on spherical coordinate geometry, ISO/IEC JTC1/SC29 WG7 MDS19642\_WG07\_N00015, October 2020, Online